EXTRAORDINARY
NETWORKS

CONNECTING THE FUTURE

Virtualization in the Data Center
The End-2-End advantage

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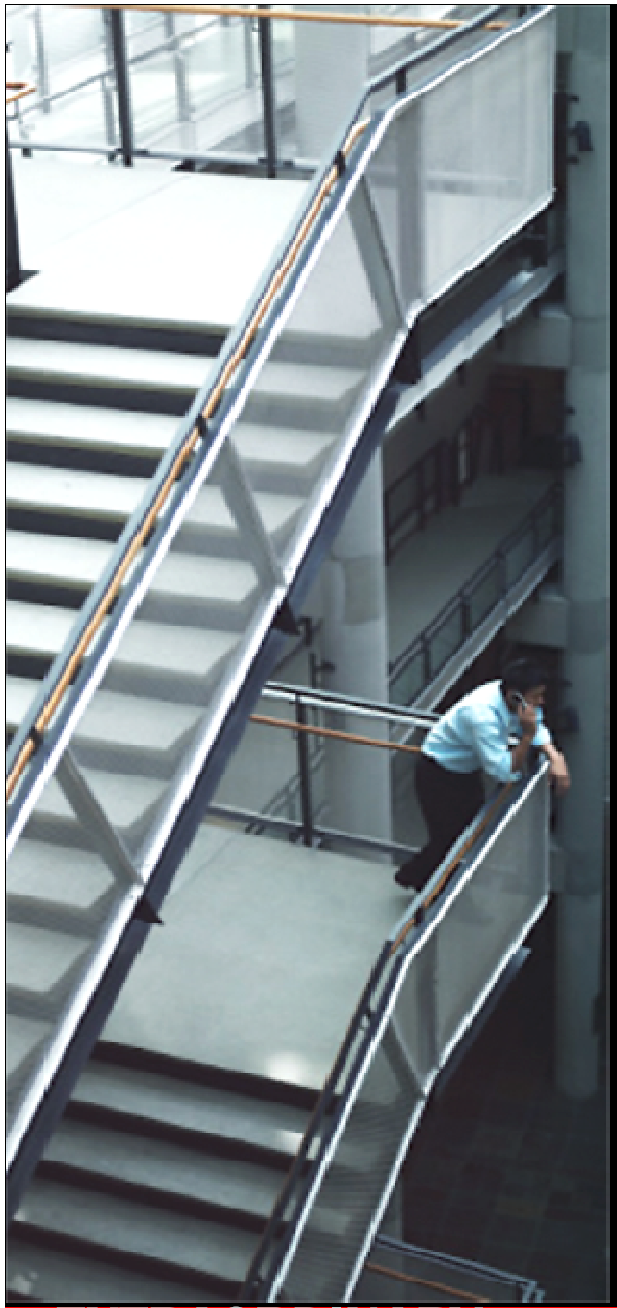

Brocade Background

- Pioneer and leader in data center networks:
  - Founded in 1995 by storage thought leaders from EMC, HP, IBM & SUN
  - **Clear leader in data center networks, >70% market share**
  - Encompassing data center, enterprise and service provider networks complimented with global services
- Public company Listed on NASDAQ as BRCD
  - Strong financial performance with revenues of $2B (’08), $1.24B (’07), $751M (’06)
  - Based in San Jose, CA with major centers in Geneva and Singapore and over 100 world-wide sales offices
  - High R&D investment profile of over 20% (vs. typical) enabling continued innovation and diversification
- 30 year DNA in networking through a combination of companies including Foundry Networks, McDATA, CNT, Silverback and SBS to expand product & service offerings

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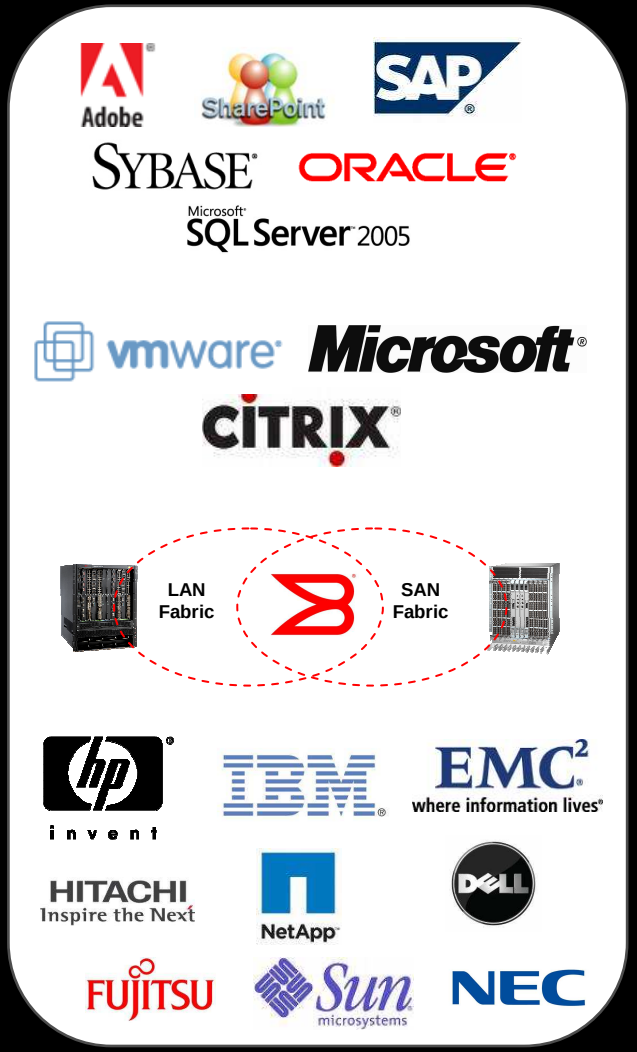
Partnerships Deliver Best-in-Class Solutions

- Brocade partners with leading blade server, rack server, mainframe, and storage providers to deliver best-in-class, end-to-end solutions
  - Proven technology: reliability, efficiency, lower TCO
  - Open standards: solution flexibility, interoperability, competitive pricing, leverage investments



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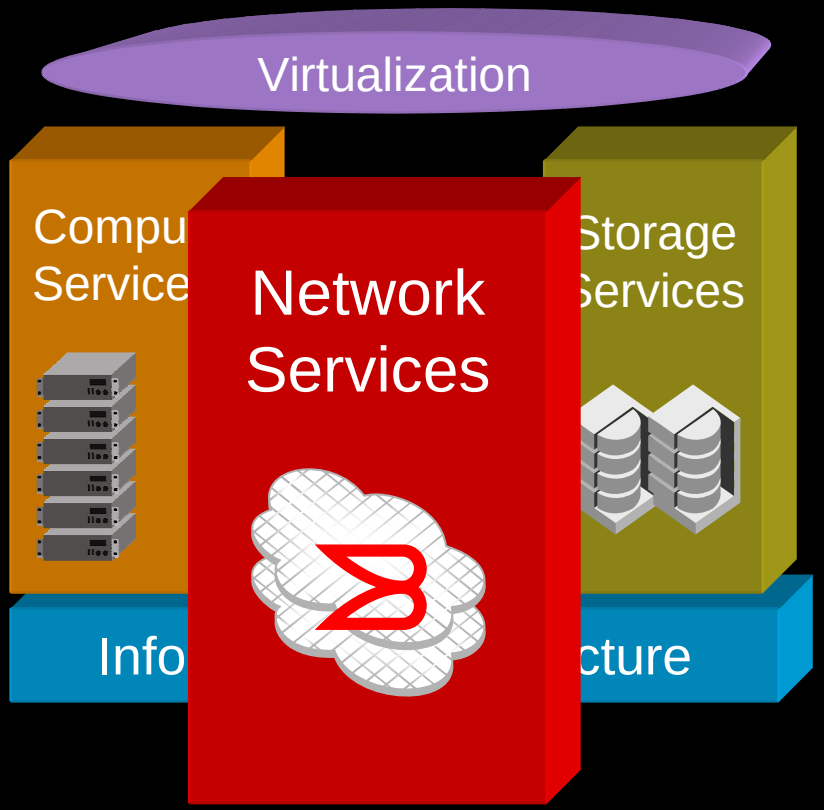
Business Demands from the Data Center Network



- Drive down Cost
- Increase Performance and Scalability
- Improve Virtualization & Mobility
- Simplify Management
- Provide Agility

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Data Center Networking

Data Center Transition

Business Drivers

- **Drive Out Cost:**
  - Consolidation
  - Efficiency
- **Improve Agility:**
  - Fast deployment
  - Tunable performance
- **Increase Reliability:**
  - Highest quality
  - Lowest risk

Technology Enablers

- **Virtualization:**
  - Host and infrastructure
  - Open systems
- **Consolidation:**
  - High density
  - High performance
- **Convergence:**
  - I/O consolidation
  - Next-generation edge

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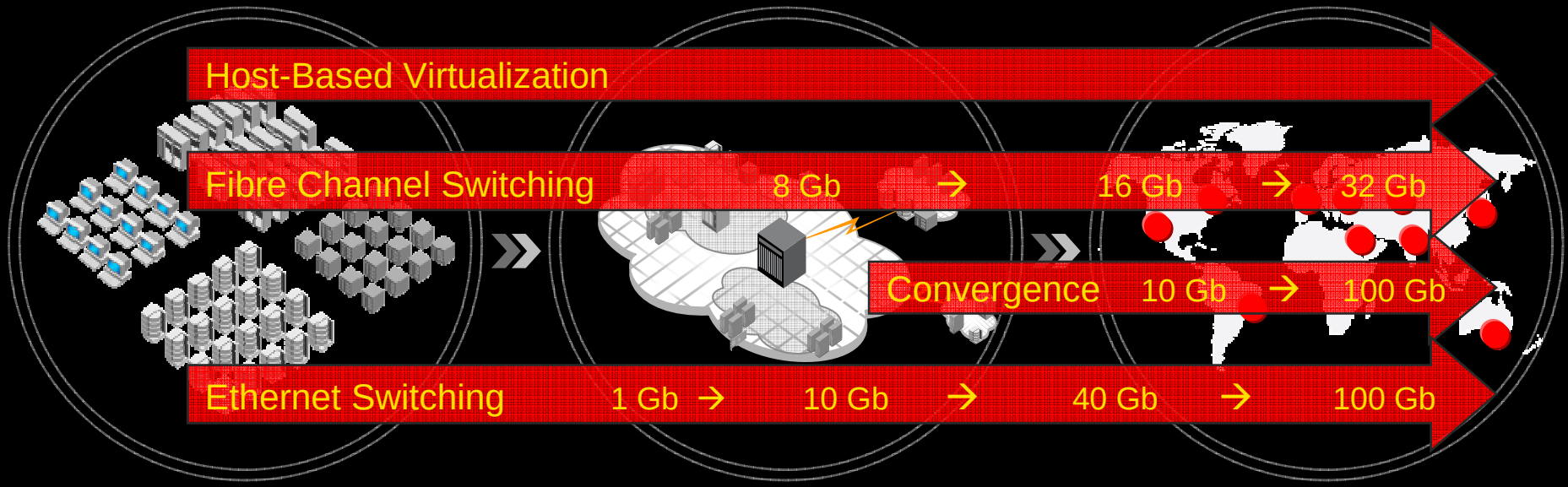
Data Center Evolution



Modular Computing
2000 to 2010

- Hardware-focused
- Network = pipes
- App/server = 1:1
- Scale by replication of hardware
- Distance is a constraint
- Host virtualization has growing adoption rate

Scale and Consolidate
2005 to 2015

- Host and network coordination
- Network = bigger pipes
- App/server = 10:1
- Scale with denser/faster hardware
- Distance is a constraint
- Host virtualization more critical, I/O-intensive apps (~25%)

Virtual Enterprise
2010 and beyond

- Software-focused/cloud-based
- Server bus and network collapse
- App/server = 100's:1
- Scale by moving apps
- Distance becomes irrelevant
- Host virtualization and orchestration are everywhere (>75% of all apps)

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Virtualization: Strategic Summary

1. **Layer 2 software switch integration**
   - Leverage, optimize partner technology
2. **Multiple hypervisors supported**
   - VMware ESX, MS HyperV, KVM, Xen,...
3. **Industry-standard port aggregation implemented**
   - No proprietary tags; IEEE 802.1 ← VEPA, VEB,...
4. **Consistent access layer virtualization across current and future platforms**
   - Ethernet, Fibre Channel, CEE
5. **Integrate with industry-leading orchestration frameworks and tools**

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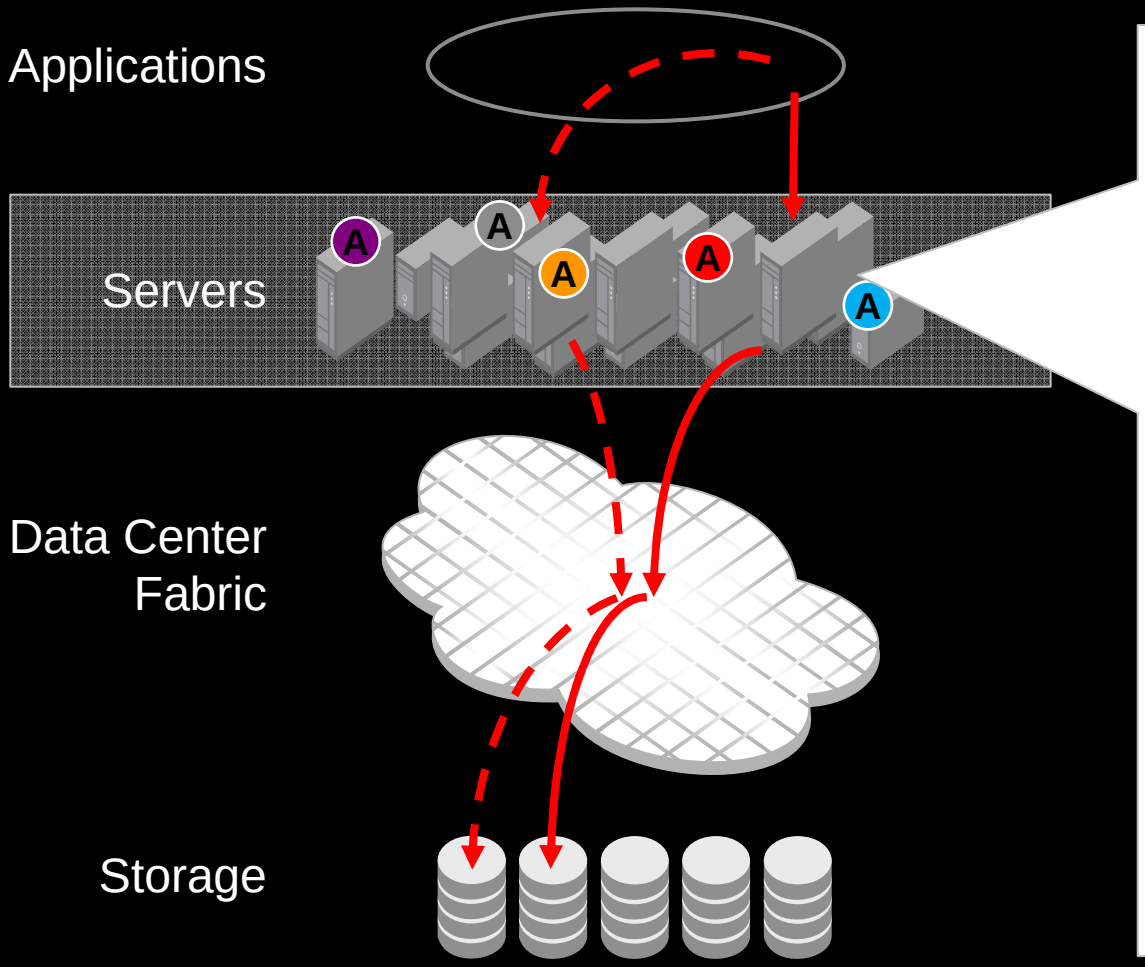
End-2-End

Server Consolidation

Enabled by server virtualization and SANs



- Physical servers are consolidated, but a higher percentage of **virtual servers** connect to the **shared storage network**
- Applications will move across virtual servers and the infrastructure, no longer attached to physical ports —**the data center fabric must support this**
- More connected elements **drive new network and infrastructure requirements**
- **VM-aware end-to-end management** (server-to-storage) becomes **critically important**

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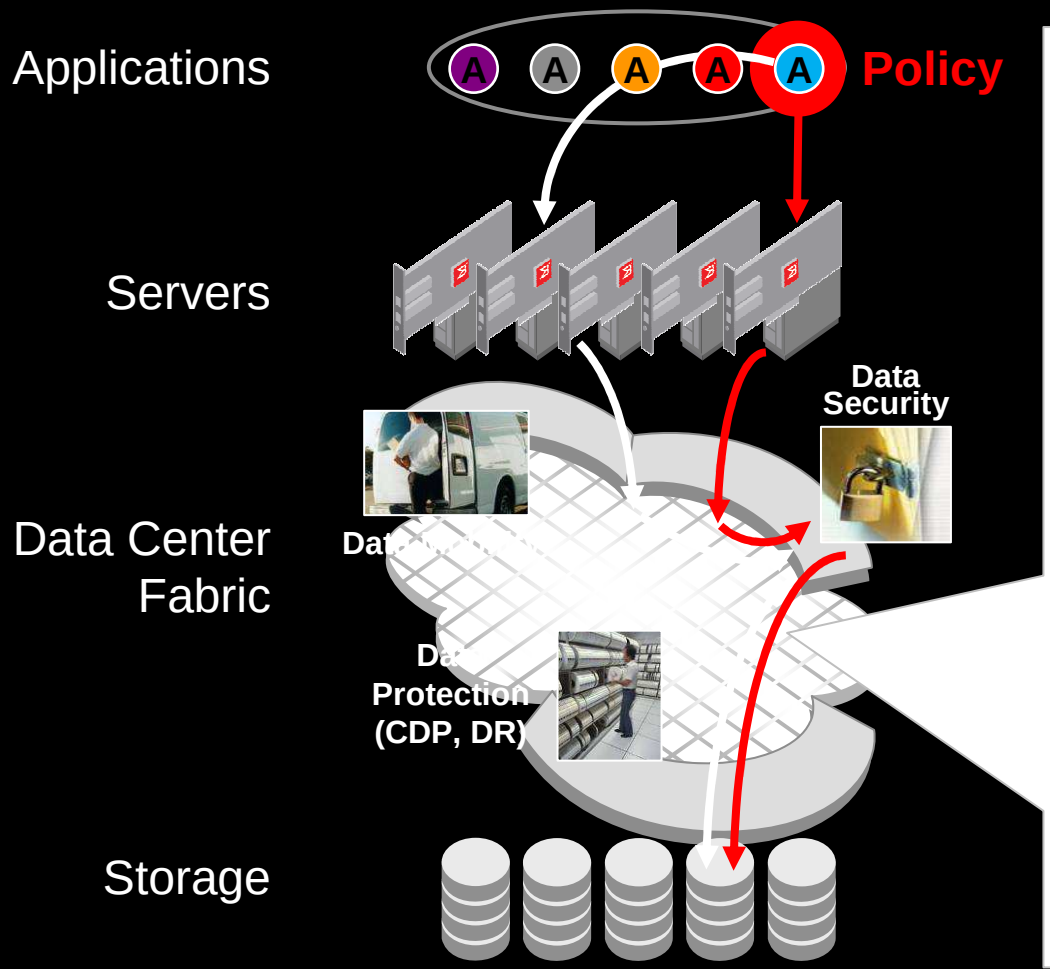
Brocade Data Center Fabric Architecture

End-to-End Policy-Based Automation (Orchestration)



- **Plug-in architecture** provides non-disruptive **choice** of best-of-breed application resources and services solutions
- Brocade has unique **policy-based** features and an architecture that easily accommodates **SLA- and application-driven automation**
- **End-to-end management** for scalable, broad connectivity across a secure, multiprotocol environment **is extended to servers, only via Brocade HBAs and CNA's**

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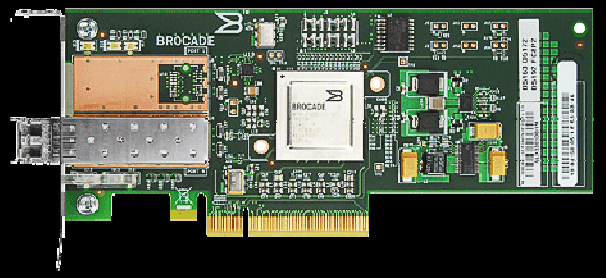
Brocade **815** and **825** Fibre Channel HBAs

Key Features:

- **8 Gbit/sec** Fibre Channel (also supports **2 and 4 Gbit/sec)**
- Single- or dual-port models
- **1600 MB/sec** throughput per port
- Up to 500,000 IOPS per port
- 50 buffer credits per port
- X8-lane PCI Express 2.0
- Low-profile design; LC-style pluggable SFP+
- Power is approximately 6 watts



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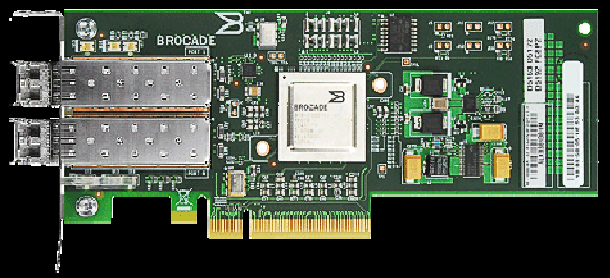

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Issues we are addressing

1. Losing Manageability
   - ✓ Solution: NPIV
2. Solve the Bandwidth Issue
   - ✓ Solution: Quality of Service (QoS)
3. Applications consuming too much Resources
   - ✓ Solution: Ingress rate limiting

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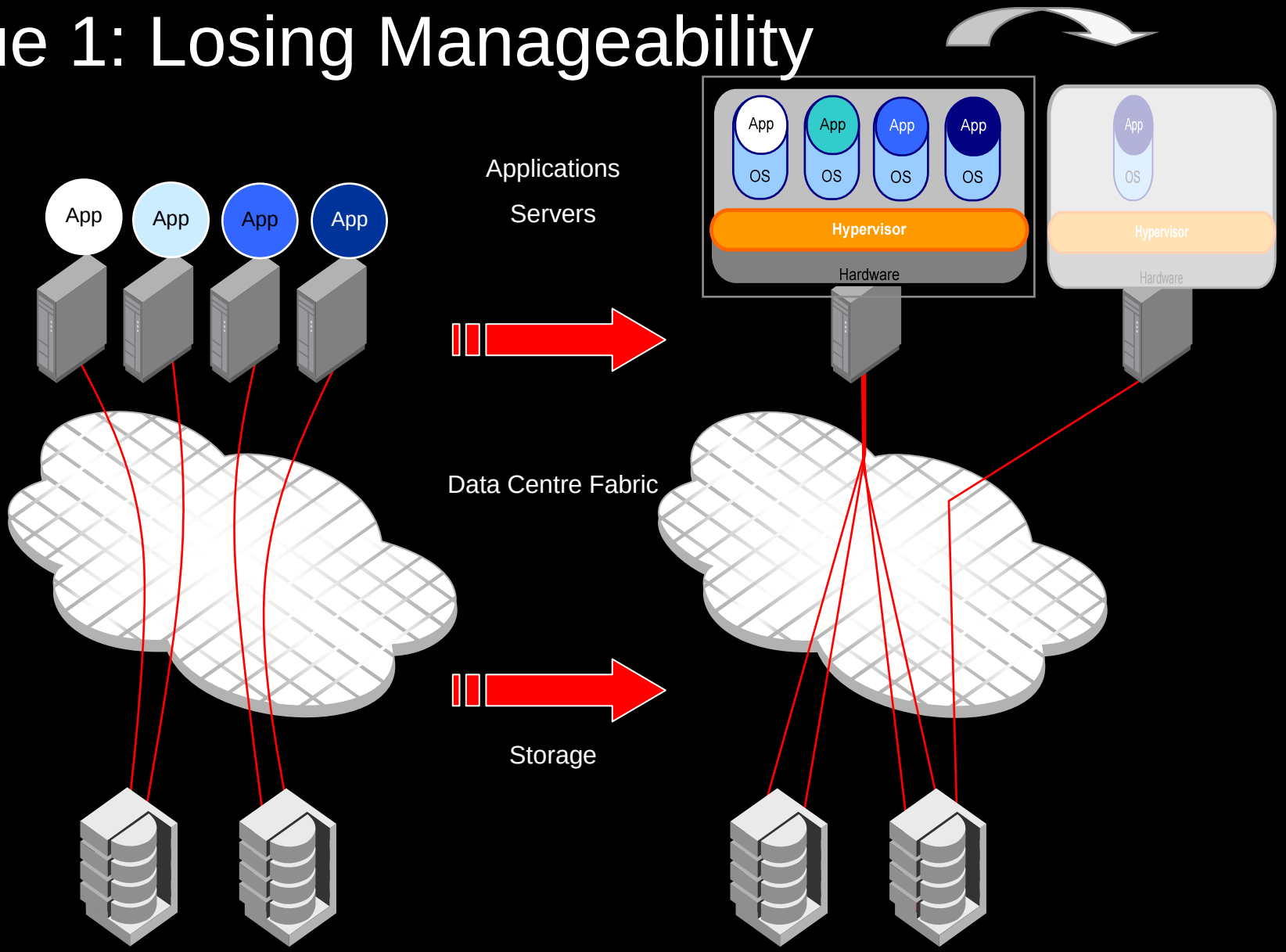
Issue 1: Losing Manageability



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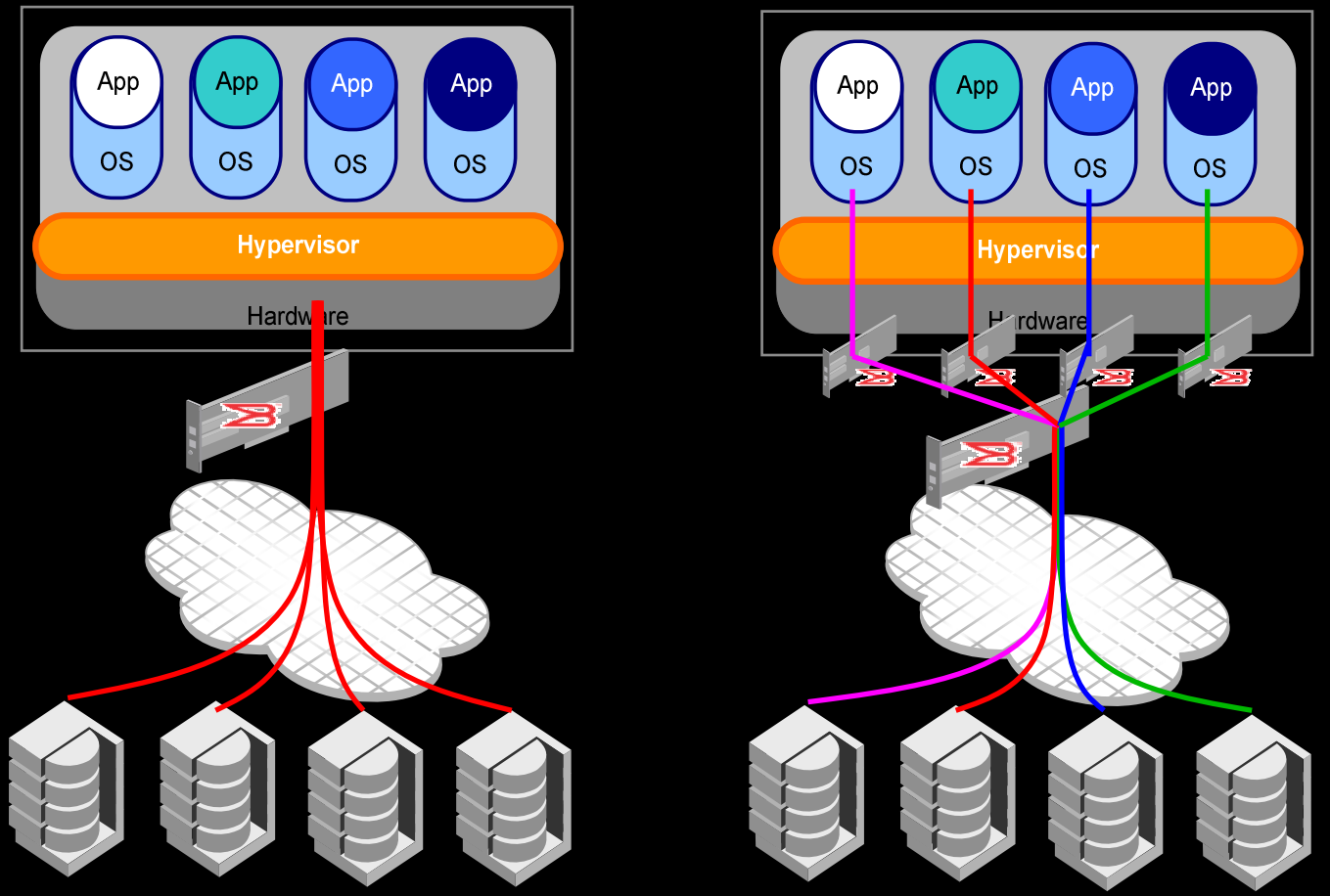
Solution - N-Port ID Virtualisation (NPIV)

- NPIV is a Fibre Channel facility allowing multiple IDs to share a single physical N_Port. This allows multiple Fibre Channel initiators to occupy a single physical port.

- **ANSI T11** standard, developed for the IBM mainframe.

- This virtual HBA, or **VPORT**, appears to the FC fabric as a physical HBA.



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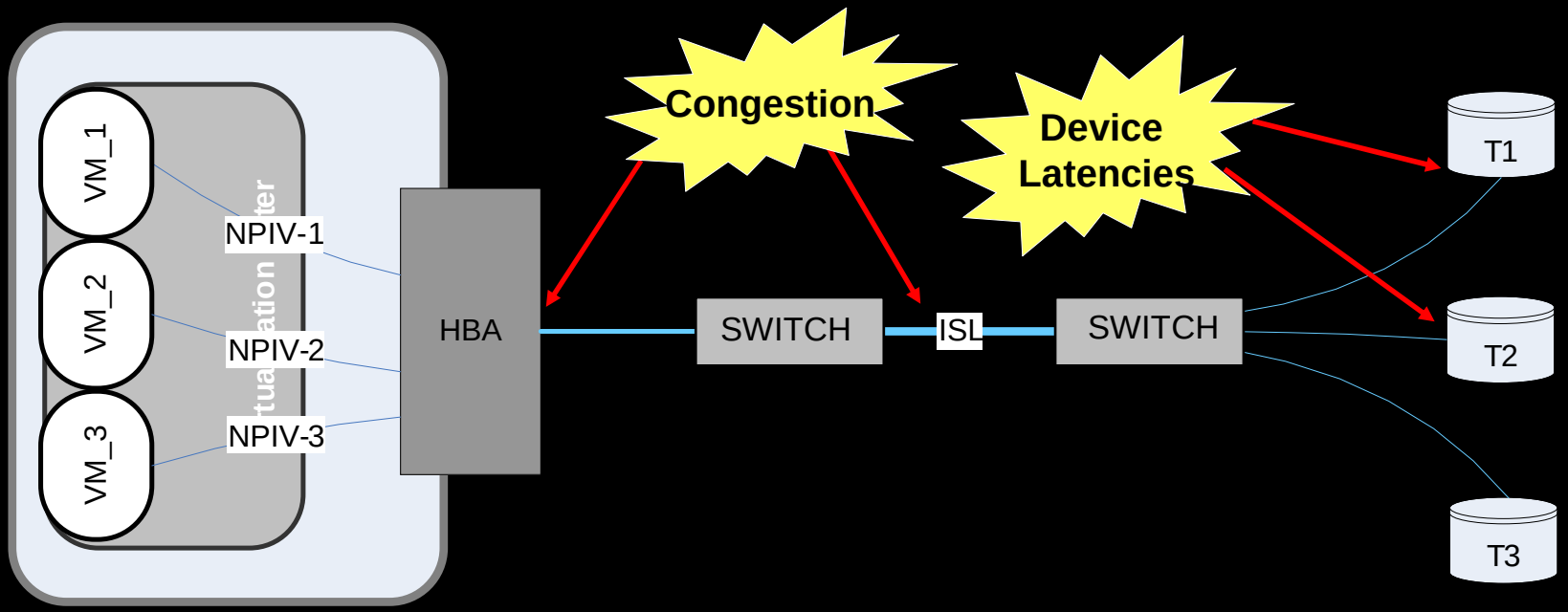
Issue 2: Solve the Bandwidth Issue

- Any congestion on the link/fabric path affects all traffic flow from the HBA through the fabric
- Problem is worse in virtual server environments
  - The more VMs the greater the potential for congestion at the host & fabric level



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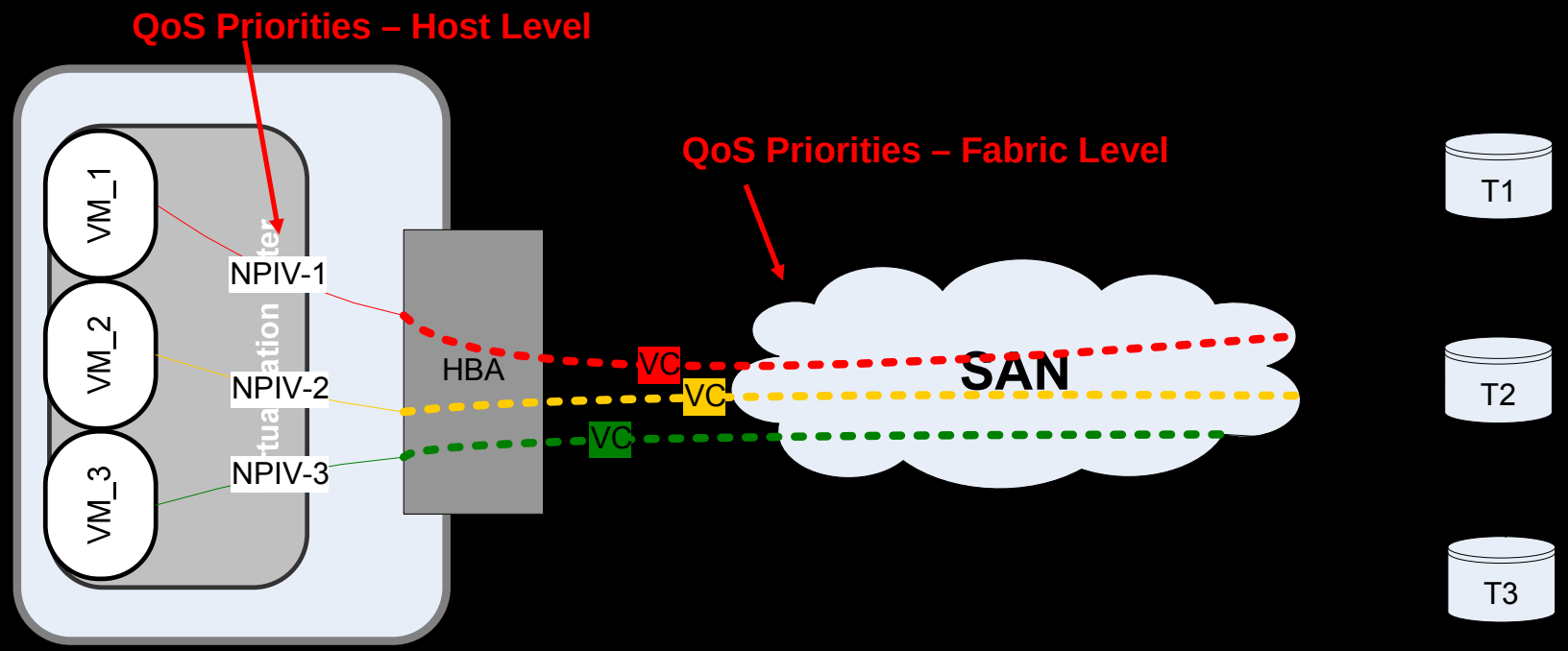
Solution – QoS at the Host & Fabric Levels

- Each VM can be linked to NPIV ports
- Each VPORT can be linked to a **QoS** priority level
  - High, Medium (default) or Low
- Each priority level is linked to the fabric QoS priority levels for the **complete solution**
  - This will **prioritize** and **isolate** data flow from host through the fabric



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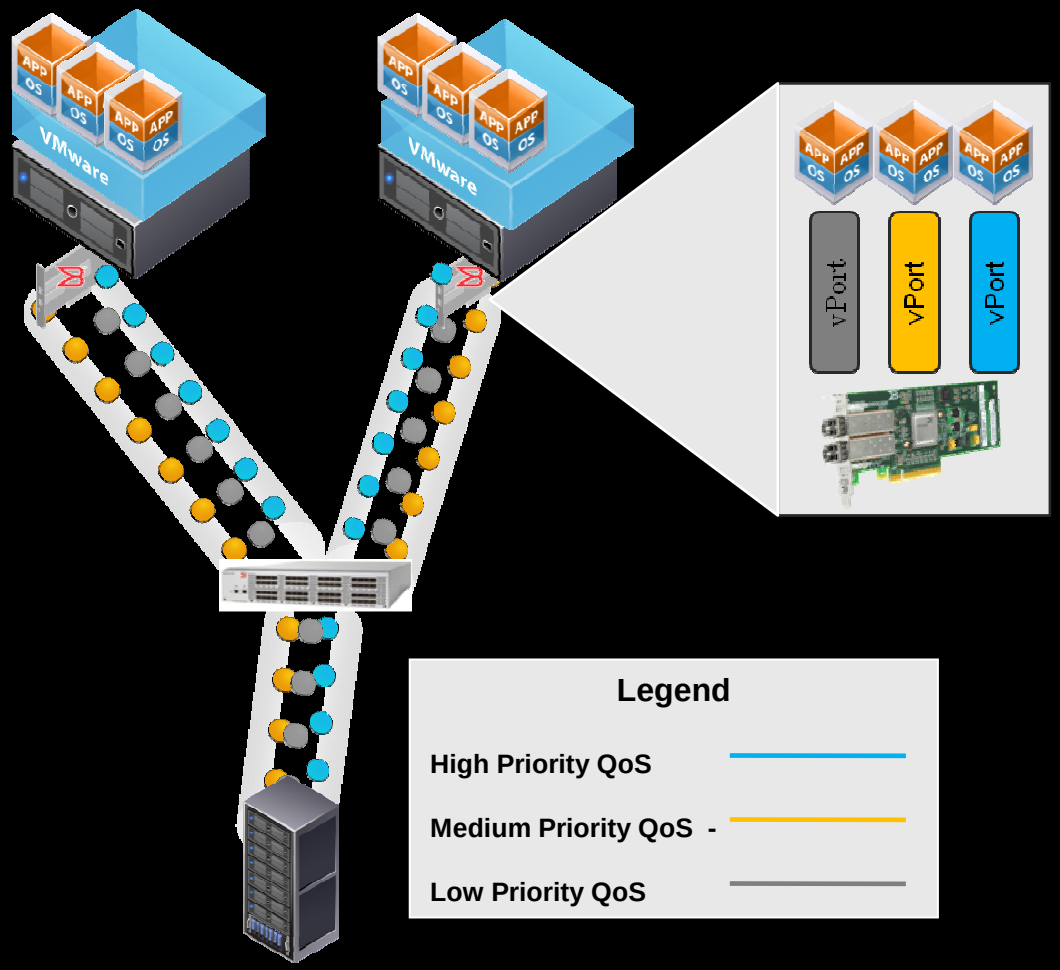
NPIV integration into vStorage

With NPIV



Benefits

- NPIV gives Storage admin visibility to VM
- Set QoS to VM
- WWN stays with VM when vmotioned
- Storage Polices kept with VM during migration

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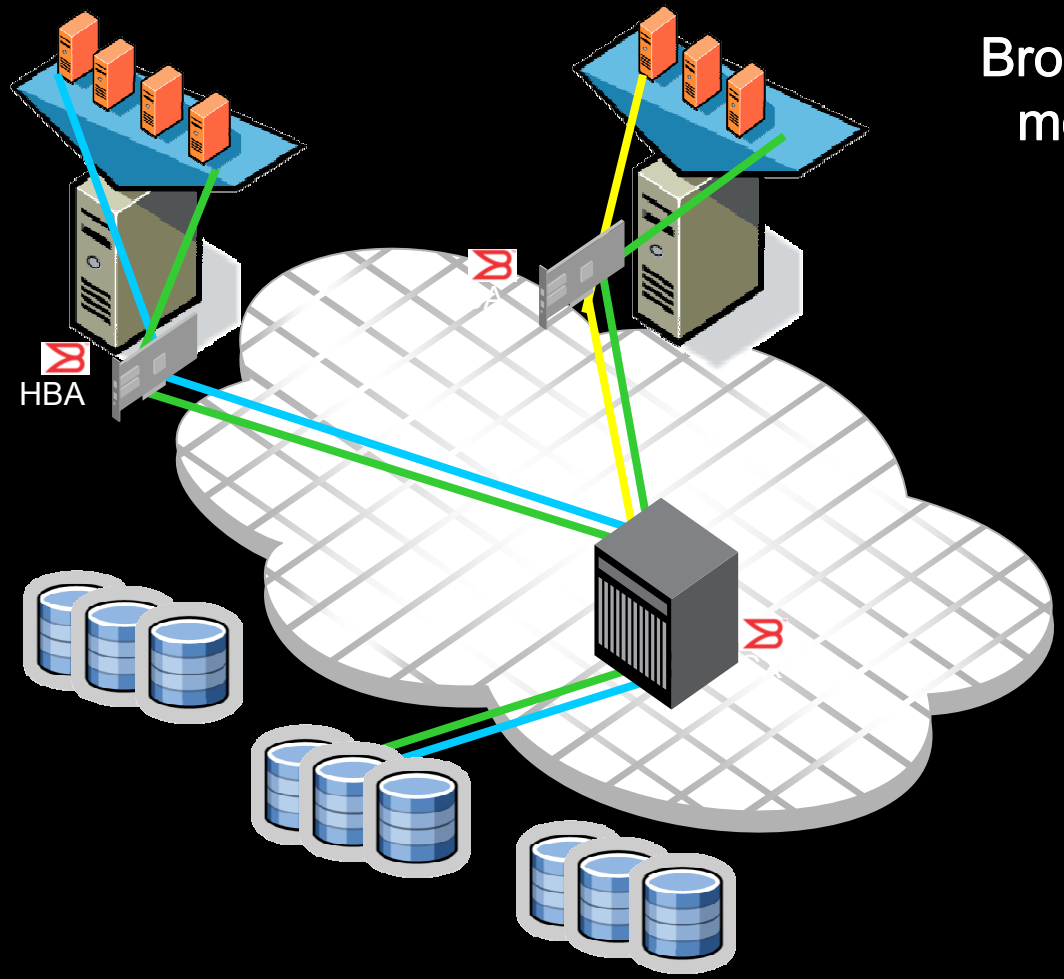
Optimizing Server Virtualization

Mobility, a key attribute in the virtualized data center



Brocade enables transparent VM mobility across the SAN

- Security and QoS attributes are attached to the “Vport” and are carried over when the VM is moved across physical servers
- Each VM gets its own virtual connection to its storage LUNs through a dedicated “Vport”
- Brocade is a key enabler of VM mobility with end to end NPiV management from host to storage.

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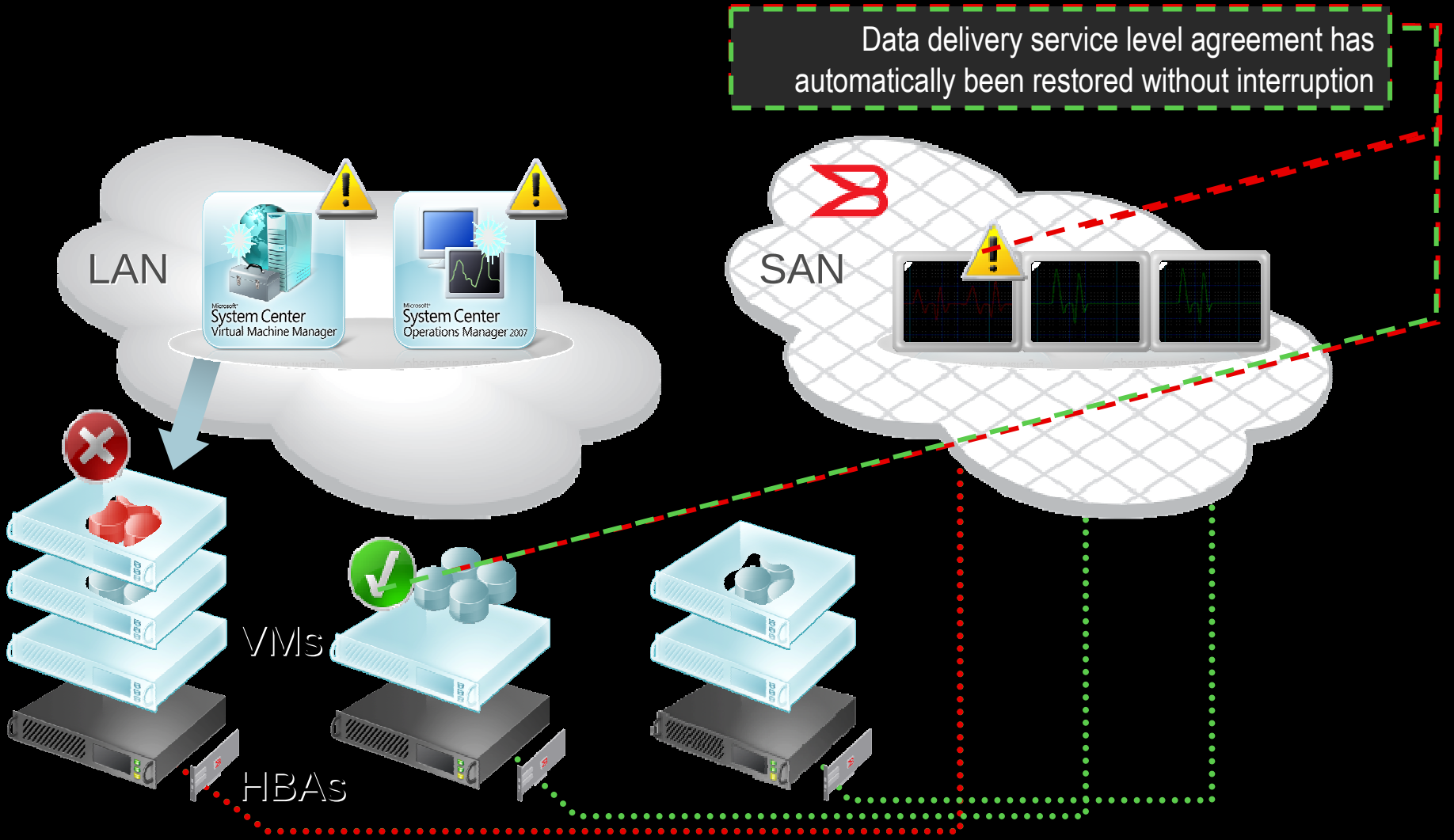
Brocade Management Pack for SCVMM

Scenario: I/O utilization exceeds threshold



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Partner Alliances

- Brocade and VMWare partner to build solutions to improve management and ease of use in virtualized server environments.
  - Building solution cases based on real world scenarios.
  - Development of management software bridging the gap between VM‘s and SAN/LAN.
- Brocade and Microsoft partner to integrate Brocade‘s Management solutions into System Center.
  - Integration of DCFM into System Center, Mgmt. Pack for SC VMM.
- Citrix/XEN uses Brocade‘s SMIS technology for disk provisioning. Further integration planned.

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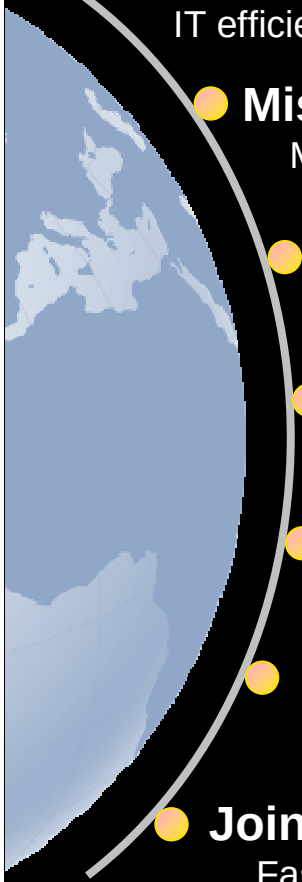
The EMC – Brocade Partnership

EMC - Brocade Partnership Highlights



- **Common vision**
  IT efficiencies through consolidation, virtualization, protection and manageability
- **Mission critical customer experience**
  More than **20,000** mutual mission-critical installations
- **Highest rated product quality**
  99.9999% reliability, leading Connectrix partner for field reliability and quality
- **Strategic technology alignment**
  Partnering closely to provide leadership for emerging technologies
- **Integration and interoperability**
  Stringent interoperability processes, EMC Support Matrix
- **Joint solutions addressing core customer challenges**
  Reference Architectures, Infrastructure Assessments, Design and Deployment Services
- **Joint support services to reduce risk**
  Fastest time-to-relief and time-to-resolution, Code Red process, Supplemental Support

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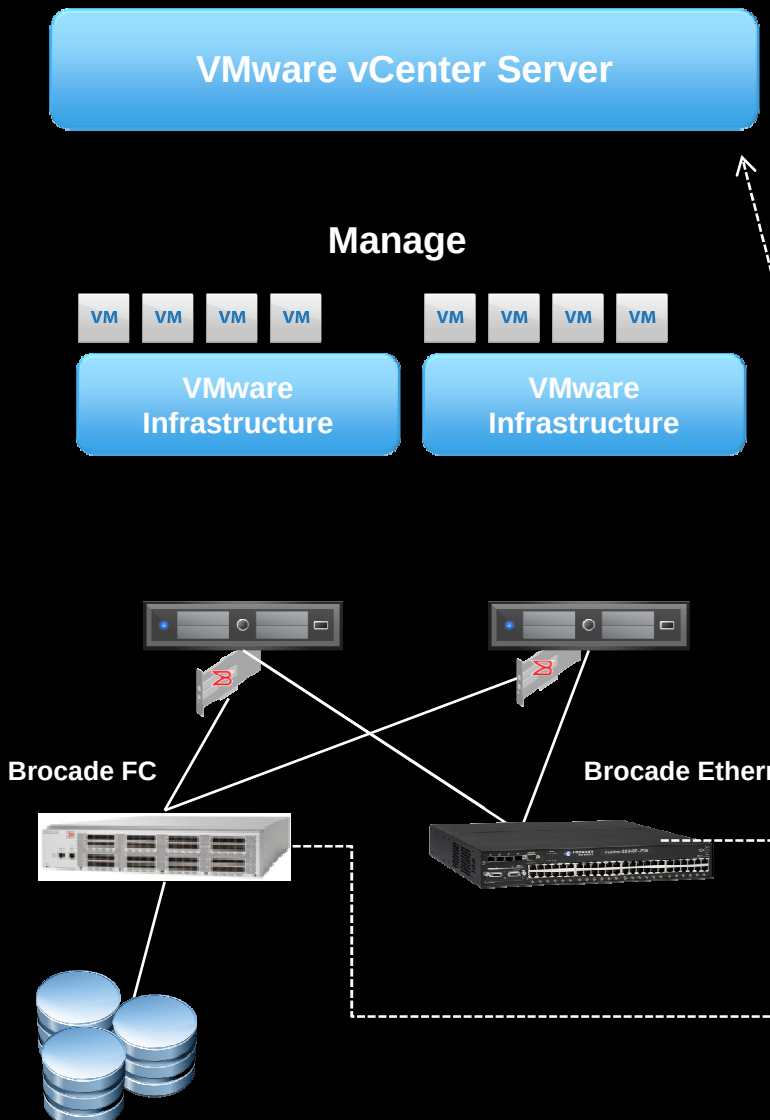
Brocade VMware Management Plug-in (In development)



Benefits

- Reports network statistics into vCenter for both SAN & LAN
- Identifies storage bottlenecks
- Pinpoint problems in the LAN or SAN and dynamically take action in Vmware environment
- Show physical network topology

An oversubscribed link is reported in DCFM. DCFM tells vCenter to migrate VM to new host

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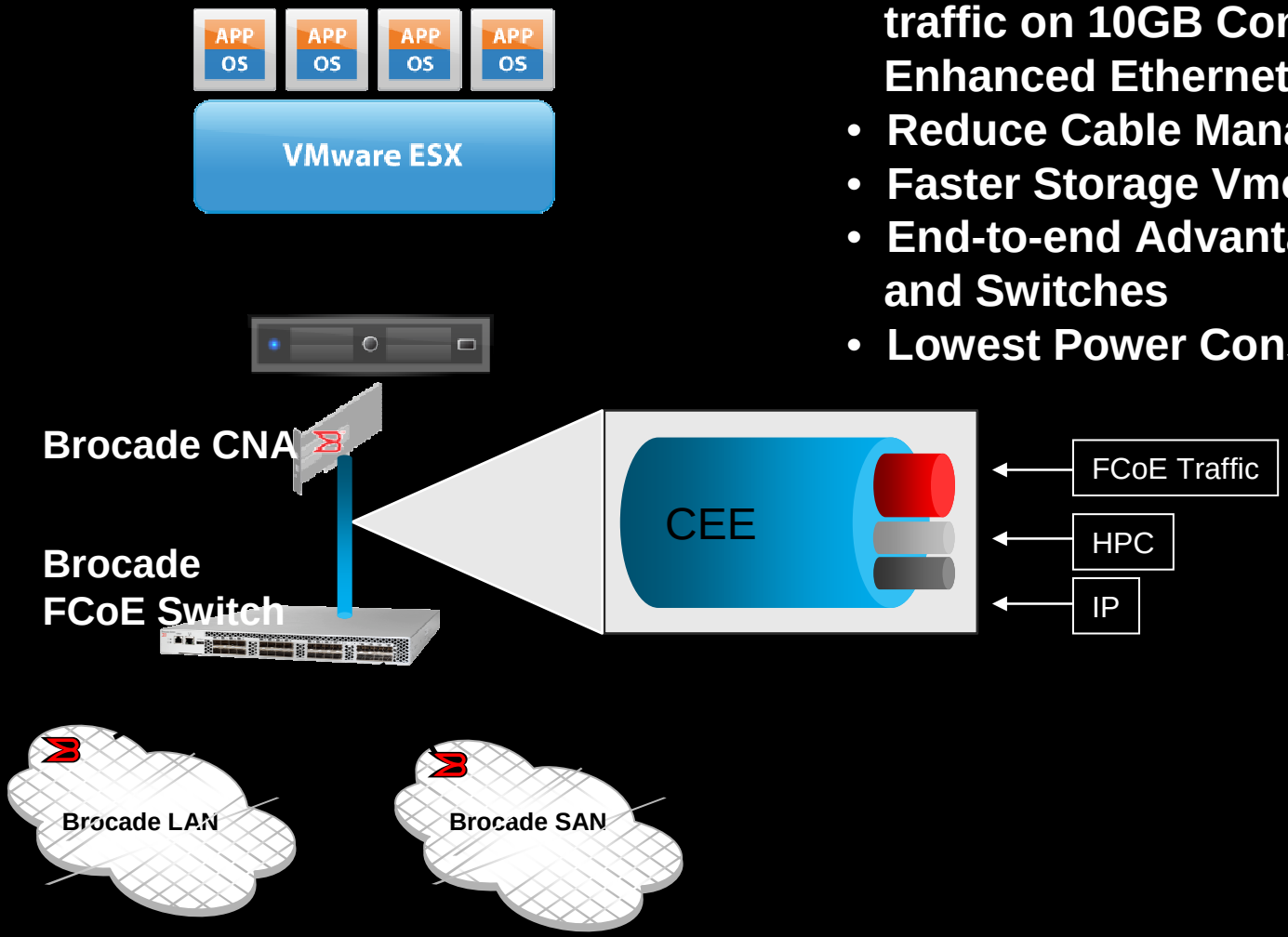
FCoE for VMware



Benefits

- Converged storage and networking traffic on 10GB Converged Enhanced Ethernet
- Reduce Cable Management
- Faster Storage Vmotion & Vmotion
- End-to-end Advantage with CNAs and Switches
- Lowest Power Consumption

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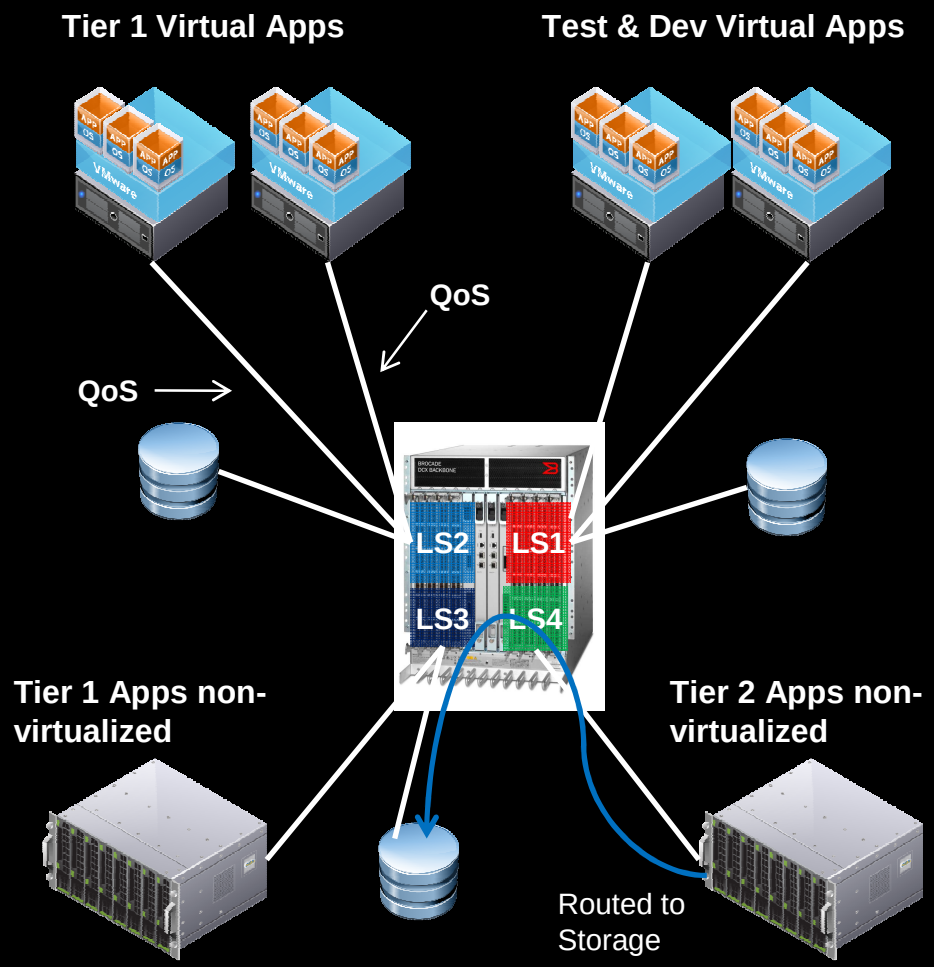
Virtual Fabrics for a VMware Environment



Need

- Isolate you critical ESX Servers from the rest of your virtual and physical environments
- Storage, management & fault isolation by application tier
- Dynamic server cluster scalability
- Simple server / storage administration

Benefits

- Port level allocation per Logical Switch
- Full support for NPIV, QoS and F_Port Trunking
- Independent management per Logical Fabric
- Independent management domains for server and storage teams

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EMC–Brocade Core Initiatives

Enabling the next-generation data center with technology and solutions available today

Consolidation	Virtualization	Protection	Next-generation Backup, Recovery, and Archiving
Efficiency/Green	VMware	Encryption	Backup
Performance	Hyper-V	RecoverPoint	Deduplication
Convergence		Business Continuity/ Disaster Recovery	Disk Library

Global Solutions and Professional Services

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Thank You